

AMENDMENTS TO THE DRAWINGS

Six sheets of drawings are attached. These drawing sheets include formal drawings and replace the prior informal drawings originally submitted.

Attachment: Six (6) Replacement Sheets

REMARKS

The present application includes claims 1-6 and 29-44. Claims 1-6 and 29-44 have been rejected by the Examiner. Claims 2-6 were objected to. By this Amendment, claims 1-6, 29, 35 and 43 have been amended. By this amendment, claims 36-37 and 42 have been cancelled.

Claims 1-6 and 29-34 were rejected under 35 U.S.C. 103(a) as being unpatentable over Alamouti et al., U.S. Pat. No. 5,933,421 ("Alamouti") in view of Gardner et al., U.S. Pat. No. 5,260,968 ("Gardner").

Claims 35-36 were rejected under 35 U.S.C. 103(a) as being unpatentable over Alamouti in view of Reece et al., U.S. Pat. No. 5,771,024 ("Reece").

Claim 37 was rejected under 35 U.S.C. 103(a) as being unpatentable over Alamouti in view of Reece further in view of Gardner.

Claims 38-39 were rejected under 35 U.S.C. 102(b) as being anticipated by Paulraj et al., U.S. Pat. No. 5,345,599 ("Paulraj").

Claim 40 was rejected under 35 U.S.C. 103(a) as being unpatentable over Paulraj in view of Gardner.

Claim 41 was rejected under 35 U.S.C. 103(a) as being unpatentable over Gardner in view of Bossard, U.S. Pat. No. 5,983,078 ("Bossard").

Claims 42-43 were rejected under 35 U.S.C. 103(a) as being unpatentable over Gardner in view of Ward et al., U.S. Pat. No. 6,104,930 ("Ward").

Claim 44 was rejected under 35 U.S.C. 103(a) as being unpatentable over Gardner in view of Song et al., U.S. Pat. Pub. No. 2003/0193917 ("Song").

Claims 2-6 were objected to because of an informality.

New corrected drawings in compliance with 37 C.F.R. 1.121(d) were required.

Claims 42-43 were rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claim 16 of U.S. Pat. No. 6,795,424.

Claims 41 and 44 were rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claim 16 of U.S. Pat. No. 6,795,424 in view of Bossard.

The Applicant now turns to the rejection of claims 1-6 and 29-34 under 35 U.S.C. 103(a) as being unpatentable over Alamouti in view of Gardner. Alamouti generally relates to frequency division duplex communications. However, as noted by the Examiner in the Office Action, Alamouti does not teach the limitations recited in claims 1 and 29 of a single antenna including a plurality of groups spaced apart sufficiently to provide spatial diversity AND at least one group including a plurality of antenna elements spaced closely enough to provide spatial filtering.

More specifically, claims 1 and 29 recite an antenna structure, wherein the antenna structure includes a plurality of antenna element groups. The plurality of groups are spaced apart at a distance sufficient to provide spatial diversity. However, at least one group includes a plurality of antenna elements. Within the group, the antenna elements are spaced close enough together to provide spatial filtering. Thus, there are two constraints (the group spacing and the element spacing), that are met in the single antenna that is recited in claims 1 and 29. Conversely, prior art antennas were typically designed to meet only one of the two constraints and not both.

Thus, Gardner teaches, at col. 6, lines 5-26, separating antennas by about half of the wavelength. Gardner specifically differentiates itself from the prior art which it mentions teaches spacing the antennas many wavelengths apart. Thus, Gardner chooses to optimize a different constraint than the prior art. However, neither Gardner nor the prior art it references teaches designing an antenna to simultaneously meet BOTH design constraints. Conversely, both Gardner and the prior art are designed to only meet one or the other of the two design constraints identified above.

Thus, the limitations recited in independent claims 1 and 29 of a single antenna including a plurality of groups spaced apart sufficiently to provide spatial diversity AND at least one group including a plurality of antenna elements spaced closely enough to provide spatial filtering are not shown in the either Alamouti or Gardner. With regard to Alamouti, the Examiner states in the Office Action that the claim limitation is not shown. With regard to Gardner, Gardner only teaches an antenna designed to meet one constraint, not both.

Consequently, independent claims 1 and 29, and their corresponding dependent claims 2-6 and 30-34, are respectfully submitted to be in condition for allowance. Similarly, independent claim 35 has been amended to recite similar limitations to the limitations in claims 1 and 29 and is consequently also respectfully submitted to be in condition for allowance.

The Applicant now turns to the rejection of claims 35-36 under 35 U.S.C. 103(a) as being unpatentable over Alamouti in view of Reece. Independent claim 35 has been amended to incorporate the limitations similar to those in claims 1 and 29 discussed above. The limitations added to claim 35 were similar to the limitations recited in dependent claims 36 and 37.

Consequently, claims 36 and 37 have been cancelled. As discussed above with regard to claims 1 and 29, amended claim 35 is also respectfully submitted to be in condition for allowance.

The Applicant now turns to the rejection of claim 37 under 35 U.S.C. 103(a) as being unpatentable over Alamouti in view of Reece further in view of Gardner. Claim 37 has been cancelled.

The Applicant now turns to the rejection of claims 38-39 under 35 U.S.C. 102(b) as being anticipated by Paulraj. Paulraj generally relates to increasing capacity in wireless broadcast systems using distributed transmission/directional reception. More specifically, as illustrated in Fig. 5 and discussed beginning at col. 7, line 68, Paulraj discusses that the spatial filter consists of d processing channels, one for each transmitted signal, where each processing channel selectively passes the one desired signal and rejects other interfering signals. That is, the spatial filter in Paulraj does not combine the signals. Rather, the output signals from the spatial filter are processed into d substreams corresponding to the outputs of the signal splitter at the transmitting side. The substreams are fed into a combiner which merges the streams. As explained at col. 10, lines 28-36, the substreams are combined to obtain the estimated source stream. The combiner essentially reverses the operation of the signal splitter on the transmitting side. That is, the combiner in Paulraj does not remove interference from signals.

However, Paulraj does not disclose a combiner for removing interference from signals. Rather, as discussed above, Paulraj merely discloses a spatial filter including processing channels that selectively pass one desired signal while rejecting other interfering signals. Further, the

combiner in Paulraj merely combines substreams to obtain the estimated source stream. Thus, Paulraj does not disclose a combiner for removing interference from signals.

Independent claim 38 recites a spatial diversity combiner for removing interference from signals. As discussed above, Paulraj does not teach a spatial diversity combiner. Consequently, independent claim 38 and corresponding dependent claim 39 are respectfully submitted to be in condition for allowance.

The Applicant now turns to the rejection of claim 40 under 35 U.S.C. 103(a) as being unpatentable over Paulraj in view of Gardner.

As discussed above, Paulraj generally relates to increasing capacity in wireless broadcast systems using distributed transmission/directional reception. However, as discussed above, Paulraj does not disclose a combiner for removing interference from signals. Rather, as discussed above, Paulraj merely discloses a spatial filter including processing channels that selectively pass one desired signal while rejecting other interfering signals.

As discussed above, Gardner generally relates to multiplexing communications signals through blind adaptive spatial filtering. Gardner discusses beginning at col. 13, line 45, a splitter/combiner coupled to an antenna in an antenna array. The splitter/combiner includes a pair of bandpass filters, the outputs of which are coupled to a controller. The splitter/combiner is used to separate the spectrally disjoint control signals received from and transmitted to the mobile user and to separate the control channel from the band occupied by active users. The control channel is used for call initiation and coordination between the user and the base station.

However, Gardner does not disclose a combiner for removing interference from signals. Rather, as discussed above, the combiner disclosed in Gardner is used to separate control signals received from and sent to remote users.

Independent claim 38, from which claim 40 depends, recites a spatial diversity combiner for removing interference from signals. As discussed above, Paulraj does not teach such a spatial diversity combiner. Further, as discussed above, Gardner does not teach such a spatial diversity combiner. Thus, neither Paulraj nor Gardner, alone or in combination, teach or suggest elements of claim 40. Consequently, dependent claim 40 is respectfully submitted to be in condition for allowance.

The Applicant now turns to the rejection of claim 41 under 35 U.S.C. 103(a) as being unpatentable over Gardner in view of Bossard.

As discussed above, Gardner generally relates to multiplexing communications signals through blind adaptive spatial filtering. However, the Applicant agrees with the Examiner's statement in the Office Action that Gardner does not teach or suggest spacing the frequency bins to reduce inter-bin interference.

Bossard generally relates to channel spacing for distortion reduction. More specifically, as explained at col. 1, lines 17-22, Bossard relates to transmitting multiple signals over a large number of channels, where two or more of the channels are affected by a component which produces intermodular distortion from the interaction of the signals of these channels. That is, intermodular distortion in Bossard is produced by the transmitting component that is transmitting many signals. Bossard discusses beginning at col. 2, line 1, channels for a first portion of a band are equally spaced from each other and form contiguous adjacent channels. If amplified, these

channels produce intermodular distortion frequencies primarily in relatively narrow bands which are spaced from each other by a frequency difference equal to the frequency spacing between their carrier frequencies. Signal to noise ratio for channels in the second part of the band may be improved if channels in the second portion are offset from the frequencies where the first portion's intermodular distortion produces are concentrated. Carrier frequencies in the second portion are also spaced from each other by the same given frequency, but are located at carrier frequencies which are not spaced a multiple of the given spacing from the carriers of the first portion.

Bossard does not teach or suggest spacing frequency bins to reduce inter-bin interference. Rather, Bossard, as discussed above, offsets a second portion of a band from a first portion to reduce intermodular distortion produced by the transmitter. In contrast, inter-bin interference is the manifestation of loss of orthogonality between different bins.

Independent claim 41 recites spacing at least one frequency bin belonging to a user to at least one sufficiently different frequency to reduce inter-bin interference. As discussed above and as acknowledge by the Examiner, Gardner does not teach or suggest spacing the frequency bins to reduce inter-bin interference. In addition, as discussed above, Bossard does not overcome at least this shortcoming of Gardner. Thus, neither Gardner nor Bossard, alone or in combination, teach or suggest at elements of claim 41. Consequently, independent claim 41 is respectfully submitted to be in condition for allowance.

The Applicant now turns to the rejection of claims 42-43 under 35 U.S.C. 103(a) as being unpatentable over Gardner in view of Ward. Claim 42 has been cancelled to simplify the issues

before the Examiner in the present application. The Applicant reserves the right to pursue the subject matter of claim 42 at a later time.

Turning now to claim 43, With regard to Gardner, the Examiner recites in the Office Action that Gardner does not teach allocating frequency bins between users such that the direction of signal arrival to adjacent frequency bins differ.

Ward generally relates to floating transceiver assignment for cellular radio. More specifically, as described beginning at col. 3, line 41, Ward discloses serving a cell with a plurality of directional beams, each capable of operating at a plurality of carrier frequencies, wherein the carrier frequencies can be floated across the plurality of beams, so as to allocate at any one time any carrier frequency to any one beam. That is, a specific frequency may be allocated to a particular beam and the frequency may be floated to another beam.

However, Ward does not teach or suggest allocating frequency bins between users such that the direction of signal arrival to adjacent frequency bins differ. Ward makes no mention of using the direction of signal arrival, nor does Ward disclose different directions of signal arrival for adjacent bins.

Thus, the limitation recited in claim 43 assigning a user to a frequency bin based at least in part on the directions of signal arrival such that directions of signal arrival for adjacent frequency bins differ is not shown in either Gardner or Ward. With regard to Gardner, the Examiner states in the Office action that the claim limitation is not shown. With regard to Ward, as discussed above, Ward makes no mention of using the direction of signal arrival, nor does Ward disclose different directions of signal arrival for adjacent bins. Consequently, independent claim 43 is respectfully submitted to be in condition for allowance.

The Applicant now turns to the rejection of claim 44 under 35 U.S.C. 103(a) as being unpatentable over Gardner in view of Song.

With regard to Gardner, the Examiner recites in the Office Action that Gardner does not teach using signal power information to distribute bins within frequency blocks.

Song generally relates to channel assignment method for multi-FA CDMA cellular systems. More specifically, as discussed beginning at paragraph [0017], Song discusses assigning a traffic channel for a mobile station in a first frequency assignment if the received power is less than a first threshold value and, if not, searching a second frequency assignment.

However, Song does not teach or suggest using signal power information to distribute bins within frequency blocks. Rather, Song relates to the selection of a traffic channel for a mobile station, not distributing bins within frequency blocks.

Thus, the limitation recited in claim 44 of using signal power information to distribute bins within frequency blocks is not shown in either Gardner or Song. With regard to Gardner, the Examiner states in the Office action that the claim limitation is not shown. With regard to Song, as discussed above, Song discusses selection of a traffic channel based on received power. Song makes no mention of using signal power information to distribute bins within frequency blocks. Consequently, independent claim 44 is respectfully submitted to be in condition for allowance.

The Applicant now turns to the objection of claims 2-6 because of an informality. The Examiner stated that the preamble of claims 2-6 were confusing. Claims 2-6 have been amended as suggested by the Examiner to read "The communication system of claim 1." In view of this

amendment, the Applicant respectfully requests the Examiner withdraw the objection regarding claims 2-6.

The Applicant now turns to the Examiner's requirement for new corrected drawings in compliance with 37 C.F.R. 1.121(d) were required. By this Amendment, six replacement drawing sheets including formal drawings have been provided. The Applicant respectfully submits that the replacement drawings sheets are in compliance with 37 C.F.R. 1.121(d) and do not contain new matter.

The Applicant now turns to the rejection of claims 42-43 under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claim 16 of U.S. Pat. No. 6,795,424. As discussed above, claim 42 has been cancelled. A Terminal Disclaimer in favor of U.S. Pat. No. 6,795,424 is enclosed. Consequently, the applicant respectfully submits that the present double patenting rejection has been traversed.

The Applicant now turns to the rejection of claims 41 and 44 under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claim 16 of U.S. Pat. No. 6,795,424 in view of Bossard. A Terminal Disclaimer in favor of U.S. Pat. No. 6,795,424 is enclosed. Consequently, the applicant respectfully submits that the present double patenting rejection has been traversed.